Final Exam Review 4th Block 1.4.12

The fastest recorded pitch in Major League Baseball was thrown by Nolan Ryan in 1974. If this pitch were thrown horizontally, the ball would fall 0.809 m by the time it reached home plate, 18.3 m away. How fast was Ryan's pitch?

$a_g = -9.8\ m/s^2$ $\quad V_{iy} = 0\ m/s$

$\Delta y = -0.809\ m$ $\quad V_{ix} = ?$

$\Delta x = 18.3\ m$ $\quad t = ?$

$a_x = 0\ m/s^2$

$$\Delta y = \cancel{V_{iy}^{\,0}t} + \frac{1}{2}a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= \sqrt{\frac{2(-0.809\ m)}{(-9.8\ m/s^2)}}$$

$$= 0.406\ s$$

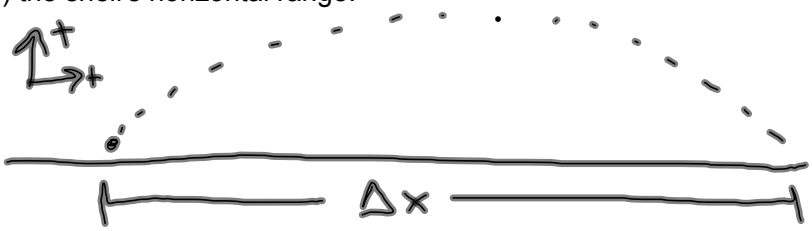
$$\Delta x = V_{ix}t + \cancel{\frac{1}{2}a_x t^{2\,0}}$$

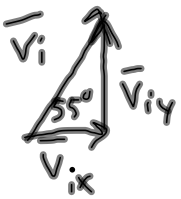
$$V_{ix} = \frac{\Delta x}{t}$$

$$= \frac{18.3\ m}{0.406\ s}$$

$$= 45.1\ m/s$$

A shell is fired from the ground with an initial speed of 1.70E3 m/s at an initial angle of 55 degrees to the horizontal and returns to the ground. Neglecting air resistance, find
a) the amount of time the shell is in motion.
b) the shell's horizontal range.





$v_{ix} = v_i \cos 55° = 975\ m/s$

$v_{iy} = v_i \sin 55° = 1392\ m/s$

$a_g = -9.8\ m/s^2 \qquad t = ?$

$a_x = 0\ m/s^2 \qquad \Delta x = ?$

a) at halfway point, $v_{fy} = 0\ m/s$

$$v_{fy} = v_{iy} + a_g t$$

$$t = \frac{-v_{iy}}{a_g} = \frac{-1392\ m/s}{-9.8\ m/s^2} = 142\ s$$

$$\text{total time} = t_{up} + t_{down} = 284\ s$$

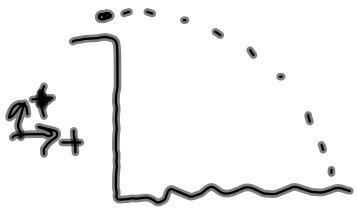
b) $\Delta x = v_{ix} t$

$= (975\ m/s)(284\ s)$

$= 276\ km$

Final Exam Review 4th Block 1.4.12

A person standing at the edge of a seaside cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface.
a) How long does it take for the stone to fall to the water?
b) With what velocity does it strike the water?



$V_{ix} = 18\ m/s \qquad t = ?$

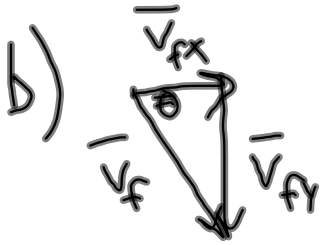
$V_{iy} = 0\ m/s$

$\Delta y = -52\ m$

a) $\Delta y = V_{iy}t^{0} + \frac{1}{2}a_g t^2$

$$t = \sqrt{\frac{2\Delta y}{a_g}} = \sqrt{\frac{2(-52\ m)}{(-9.8\ m/s^2)}}$$

$$= 3.25\ s$$

b) 

$V_{fx} = V_{ix} = 18\ m/s$

$V_{fy} = V_{iy}^{0} + a_g t$

$= (-9.8\ m/s^2)(3.25\ s)$

$= -31.9\ m/s$

$\bar{V}_f = 36.6\ m/s\ @\ 61.3^{\circ}\ S\ of\ E$

A dog (14.0 kg) and a monkey (8.0 kg) are playing tug-of-war on a frictionless surface. They are attached by a rope, and the dog pulls on the monkey's collar with a force of 55.5 N.
a) What happens to the motion of each animal?
b) Which animal receives the most force?
c) Calculate the acceleration of the monkey.

a) both move towards each other

b) same force

c) $\sum F = ma$

$F_{pull} = ma$

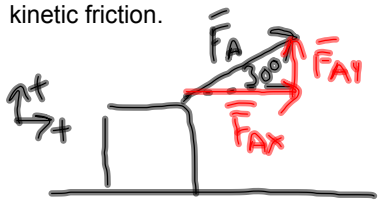
$a = \frac{F_{pull}}{m}$

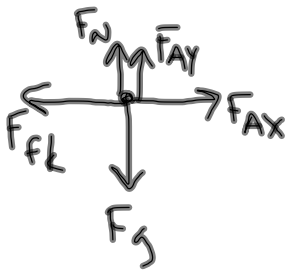
$= \frac{55.5\ N}{8\ kg}$

$= 6.93\ m/s^2$

Final Exam Review 4th Block 1.4.12

A block with mass 20 kg is pulled along a horizontal surface at constant velocity with a force of 100 N at an angle of 30 degrees above the horizontal. Find the coefficient of kinetic friction.





$$F_{fk} = \mu_k F_N$$

$$\mu_k = \frac{F_{fk}}{F_N}$$

$$= \frac{86.6\,N}{146\,N}$$

$$\approx 0.593$$

$$\Sigma F_x = m\cancel{a_x}^{\,0} \quad a_x = 0$$

$$F_{Ax} - F_{fk} = 0$$

$$F_{fk} = F_{Ax}$$

$$= F_A \cos(30°)$$

$$= (100\,N)\cos(30°)$$

$$= 86.6\,N$$

$$\Sigma F_y = 0$$

$$F_{Ay} + F_N - F_g = 0$$

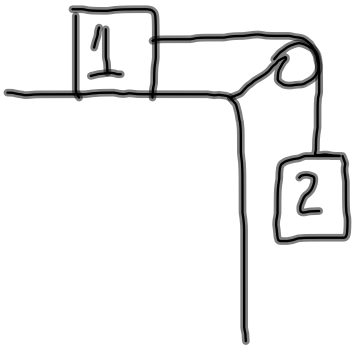
$$F_N = F_g - F_{Ay}$$

$$= ma_g - F_A \sin(30°)$$

$$= (20\,kg)(9.8\,m/s^2) - (100\,N)\sin(30°)$$

$$= 146\,N$$

A block of mass 9.89 kg is on a frictionless horizontal surface and is attached to a block of mass 5.88 kg that is hanging by means of a rope passed over a pulley. Find the acceleration of the mass on the table.



only force that causes movement is F_{g2}

$$\Sigma F_{total} = M_{total}\, a$$

$$a = \frac{F_{g2}}{m_1 + m_2}$$

$$= \frac{m_2 a_g}{m_1 + m_2}$$

$$= \frac{(5.88\ kg)(9.8\ m/s^2)}{9.89\ kg + 5.88\ kg}$$

$$= 3.65\ m/s^2$$